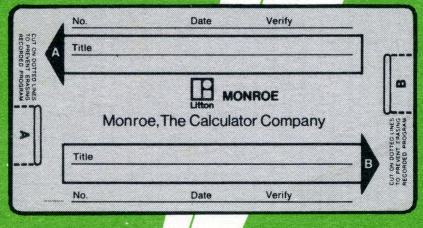
Litton MONROE

OPERATING INSTRUCTIONS

model 1830 programmable printing calculator



Monroe, The Calculator Company

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INTRODUCTION

The Model 1830 Programmable Printing Calculator combines the advantages of simple operation with extensive capabilities for problem solving. The Model 1830 may be used simply as a calculating machine or it may be used to write and execute business-oriented programs. It is programmable from the keyboard. Programs may be stored in memory as well as written on magnetic cards. Input is either from the keyboard or from magnetic cards. The magnetic card reader is built into the Model 1830 calculator.

A special feature of the Model 1830 is that many standard business and financial calculations and procedures are permanently programmed in the calculator and may be accessed with standard program codes. In addition, a number of blank keys on the keyboard, called user-definable keys, are reserved for functions that may be selected by the user. These may be either the standard functions and procedures mentioned above, or programs written by the user. The user-definable keys can be easily labeled for clarity. When the key's function is changed, the label can be changed.

You don't need to learn a complex machine language to program the Model 1830. Simply enter your problem into the calculator as you would write it, number by number and arithmetic operation by arithmetic operation. The calculator automatically computes and prints the solution.

The Model 1830 keyboard provides all the standard business arithmetic operations and, in addition, has the user-definable (blank) keys that can immediately address programs and functions stored in memory. Since the calculator was designed primarily for business and financial operations, the functions that can be requested include simple interest, compound interest, compound rate, annuities, calendar date, and coupon periods.

The calculator's simple mode of operation greatly reduces chances for error, but if you should attempt an illegal operation (for example, trying to divide by zero), the calculator indicates an error or overflow. When either indication is observed, merely reset or clear the calculator and proceed with the problem, using valid data.

For long complex problems, the Model 1830 provides 512 program steps, with additional steps available as an option, in increments of 512 steps, up to as many as 4096 steps. Appendix B discusses this option. Programming is simplified by keys that permit easy removal of incorrect steps and insertion of new steps, and by full program listing at the touch of a key.

The programming felxibility of the Model 1830 is further enhanced by symbolic addressing and indirect addressing techniques. A single key makes these two techniques immediately available to the programmer as described in the Model 1830 Programming Reference Manual.

The Model 1830 is designed to handle large amounts of data in its ten scratch pad registers (as the name implies, for short problems and intermediate operations) and in its 64 main data registers. Options are available to expand data storage capacity up to 512 main data registers, in increments of 64. (See Appendix B for details of these options.)

A magnetic card device, built into the calculator, enables you to realize the full potential of the Model 1830. Complex programs, stored on magnetic cards, may be entered into the calculator at the flick of a switch. You can write your own programs onto cards by using the magnetic card device, or you can use prepared programs from the Monroe program library. This library includes many programs related to business and financial applications. Combining the resources of Monroe's program library with the power and flexibility of the calculator gives you the capability to solve many of the problems that formerly required larger computers . . . at your desk.

We believe your Monroe Model 1830 will quickly become the center of your problem-solving activities, from quick keytop calculations to complex problems requiring numerous data inputs and manipulations. And these instruction manuals have been specifically designed to bring you to the proper level of calculator "know-how" for your level of use. Read the following paragraphs carefully to determine which manual or combination of manuals is most suitable for your particular situation.

USE OF MANUALS

Four manuals are available for complete information on the operation and programming of the Model 1830 Calculator. These manuals are listed by the operations you may wish to perform and the experience you have had on Monroe calculators.

Operations Desired and Experience of User	Manuals Required
Run prepared programs only	Model 1830 Programmable Printing Calculator, Operating Instructions
Run prepared programs and perform simple keyboard calculations	Model 1830 Programmable Printing Calculator, Operating Instructions
Run prepared programs, perform keyboard calculations — like to learn programming	Model 1830 Programmable Printing Calculator, Operating Instructions Fundamentals of Programming
Run prepared programs, perform keyboard calculations and simple keyboard programming — some programming experience (or has read Fundamentals of Programming)	Model 1830 Programmable Printing Calculator, Operating Instructions Programming Reference Manual for the Model 1830 Programmable Printing Calculator
Perform keyboard calculations, do complex programming — extensive programming experience	Model 1830 Programmable Printing Calculator, Operating Instructions Programming Reference Manual for the Model 1830 Programmable Printing Calculator Advanced Programming Reference Manual for the 1800 Series Programmable Printing Calculators

These publications are available from your nearby Monroe Sales Representative.

SCOPE

The information in the following sections will acquaint you with all the keys and switches required for keyboard calculations, and will demonstrate the most effective way to use them. Information is also presented to allow you to perform simple automatic operations on the calculator.

KEYBOARD AND PRINTER

The calculator has two main operating sections:

- A keyboard to enter data and select operations to be performed.
- A printer to provide a permanent record of the results of each operation.

Keyboard

The calculator keys and switches, illustrated on page 1-3, can be divided into seven groups: control, data entry, arithmetic, algebraic, register control, user-definable, and automatic operation. The keys in the first six groups are summarized below (they will be discussed in detail later):

- Control

  Use these switches to turn power on and off and to establish the necessary operating mode:

  Power ON

  Establish run, step, or load mode, for programs

  This indicator light is on whenever the calculator is ready to accept data entry:

  Idle light

  Use these switches and keys to control printing and print format:

  Print

  Advance the paper

  Define number of decimal places printed

  Autopoint/Round switch; determine whether numbers are to be rounded

  Use these keys to establish the operating conditions and set certain registers to zero:

  Clear entry

  Reset

Model 1830 Keyboard

- Data Entry

  Use these keys to enter numbers into the calculator in mixed decimal form:

  [0] – [9] Numerals 0 through 9

  [.] Decimal point

  [CHG SIGN] Change sign

- Arithmetic

  Use these keys to perform arithmetic operations:

  [+] Add to accumulator

  [–] Subtract from accumulator

  [◊] Recall subtotal from accumulator

  [*] Recall total and clear accumulator

- Algebraic

  Use these keys to perform multiplication and division operations:

  [×] Multiply

  [÷] Divide

  [=] Equals

- User-Definable

  Use these keys to address specific locations where programs have been stored in the calculator memory:

  [ ] Function program or algebraic program address keys

  [□] Special function program address key (followed by a numeral key [0] through [9], [.], or [CHG SIGN])

- Register Control

  Use these keys to store numbers in the scratch pad registers or the main data registers and to retrieve the data from those storage registers:

  Store data in scratch pad register

  Recall subtotal from scratch pad register

  Recall total from scratch pad register

  Add to contents of scratch pad register

  Store data in main data register

  Recall data from main data register

- Automatic Operation

  A number of switches at the top of the keyboard and the [RESUME] key are used for automatic operation and programming. You will learn about some of these switches in the Automatic Operation section of this manual. The remaining switches and keys are described in the Programming Reference Manual.

Printer

As you work your problems, you can have the calculator print a record of each operation performed. To make negative numbers readily distinguishable, the calculator prints the numbers in red with the minus sign next to the leftmost digit. Commas are printed between each group of three digits to the left of the decimal point as if you were writing the number.

To make it easier to verify the steps used in working a problem, the calculator prints a symbol for each operation along the right-hand edge of the tape. You will learn the symbols as you work the problems given throughout the manual.

PREPARING FOR OPERATION

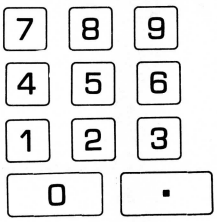
The calculator power cord requires a three-receptacle ac outlet. You can use an adapter if a three-receptacle outlet is not available. After connecting any peripheral equipment and plugging in the calculator, you are ready to begin operations. Directions for replacing the paper and the printer ribbon are given in Appendix A.

Turn on the power switch to start the calculator. Setting this switch to the STDBY (standby) position turns the calculator off, but does not remove power from the calculator memory. Therefore, if a program is stored in memory, it will not be erased in the standby mode. In going from STDBY to ON, a RESET (see below) is performed; all other memory and register data are retained. From the OFF position, you should go directly to ON, without pausing at STDBY.

Set this switch to RUN for keyboard operations. (The STEP and LOAD settings are used to prepare programs.)

The idle light is on whenever the calculator is ready to accept data entry. During calculations the light goes off and remains off until the calculations have been completed. (A flashing light indicates an error or overflow condition; these conditions are discussed later in this section.)

ENTERING AND PRINTING DATA



These keys are used to enter data into the calculator, in the same order that you would write it. The data is placed in the entry register (E-register). You may enter data in mixed decimal format with a maximum of 13 digits, decimal point, and sign; or you may enter a decimal fraction with a decimal point, followed by a maximum of 12 digits and sign.

CLEAR ENTRY RESET If you accidentally key the wrong number, you can correct it with either the CLEAR ENTRY or RESET key. The CLEAR ENTRY key clears the E-register without affecting any operations you may have in progress. The RESET key clears the E-register and also nullifies any operation you may have in progress. The CLEAR ENTRY key does not cause a symbol to be printed on the printer tape. The RESET key causes the following symbol to be printed: • 0 0 Λ

[CHG SIGN] To change the sign of the number in the E-register (from positive to negative, or vice versa), depress the [CHG SIGN] key. You may depress this key any time during numeral entry.

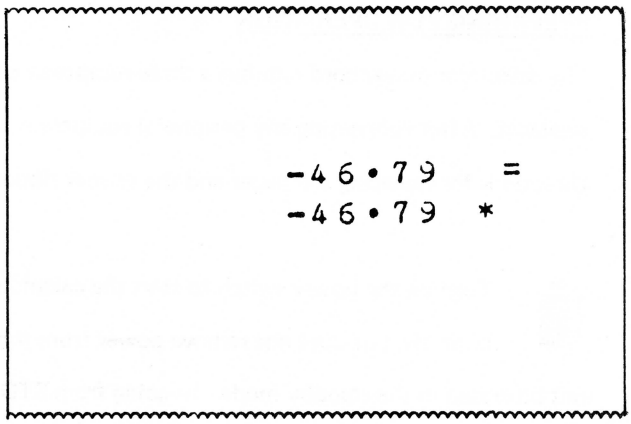
Example. To enter the number –46.79, depress:

[CHG SIGN] [4] [6] [.] [7] [9] [=]

or

[4] [6] [.] [7] [9] [CHG SIGN] [=]

Note that a negative number is printed in red with a minus sign to the left of the most significant digit.



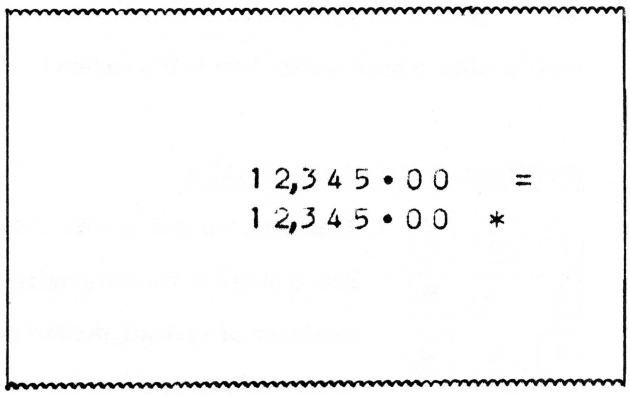
PRINT

When this switch is set to PRINT, normal printing occurs. Numeral entry will not cause printing unless it is followed by an operation; the operation can be as simple as [=]. The [CLEAR ENTRY] and [SET D.P.] keys do not cause printing. This switch can be set to PRINT for all manual keyboard operations.

Example. To enter and print the number 12,345, set the PRINT switch to PRINT and depress:

[1] [2] [3] [4] [5] [=]

Now set the PRINT switch to the lower position and depress the same sequence of keys. Notice that no printing occurs. Next, set the switch to PRINT and depress [=]. The number previously entered in the E-register is printed.



[ADV] This key, located next to the printer, causes the paper in the printer to advance. If the key is depressed and held, the paper continues to advance until the key is released.

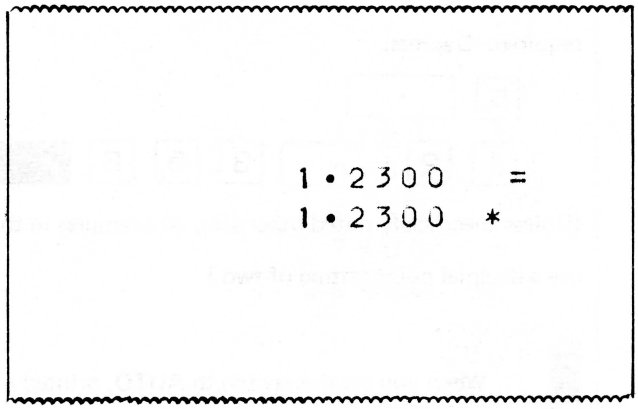
[SET D.P.] You use the [SET D.P.] key, followed by a single digit [0] through [9] or [.], to define the basic format in which numbers are to be printed. A single digit ([0] through [9]) specifies the number of decimal places normally printed to the right of the decimal point. The sequence [SET D.P.] [.] specifies an implied setting of two decimal places.

Example. Set the calculator to print four fractional digits; enter the number 1.23. Depress:

[SET D.P.] [4]

[1] [.] [2] [3] [=]

Notice that four decimal places are printed.

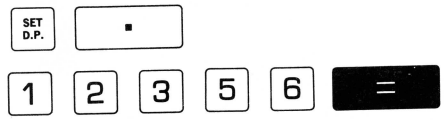


Once you have set the decimal point position, it remains until you change it or until the calculator is turned off. (When you turn on the calculator, the decimal point position is automatically set to two.) However, if you enter a number or calculate a number that requires a decimal point position different from the one you have set, in order to print the complete number, the calculator can automatically shift the decimal point left or right to accommodate the number. This positioning depends on the setting of the AUTO / ROUND switch (described below).

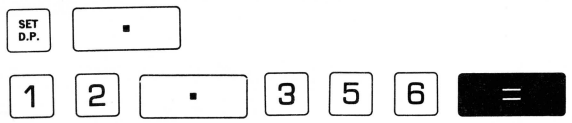
If you want, you can enter numbers and let the calculator automatically place the decimal point. The sequence [SET D.P.] [.] specifies an implied setting of 2. With this setting, you merely key the numbers to be entered and do not have to key the decimal point. The decimal point position is assumed to be two places to the left of the last digit entered (including zeros). If the [SET D.P.] [.] sequence is specified and a decimal point is entered with the number, that explicit decimal point takes precedence over the implied position.

Examples.

1. To enter the number 123.56, using an implied setting of two decimal places, depress:



2. To enter the number 12.356, an explicit decimal point is required. Depress:



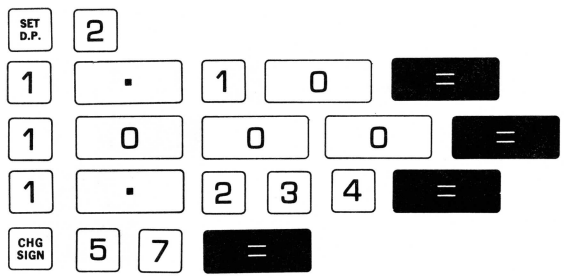
(Unless specifically noted otherwise, all examples in this manual use a decimal point setting of two.)

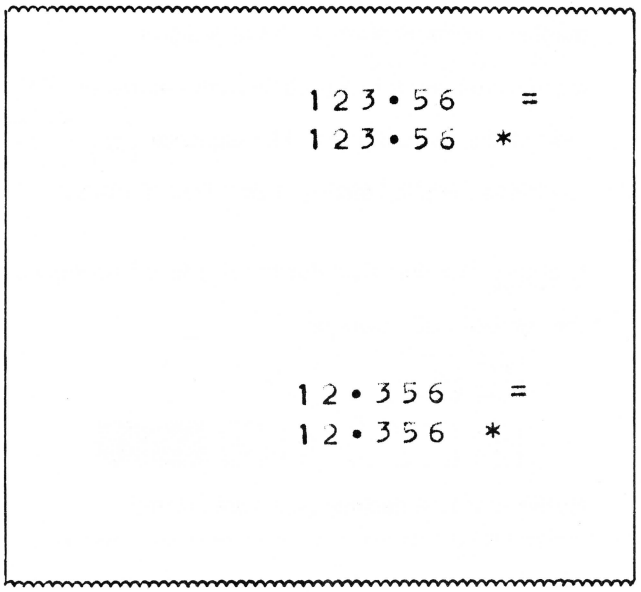
When you set this switch to AUTO, printed numbers are not rounded. Numbers are printed in accordance with the SET D.P. key, except that:

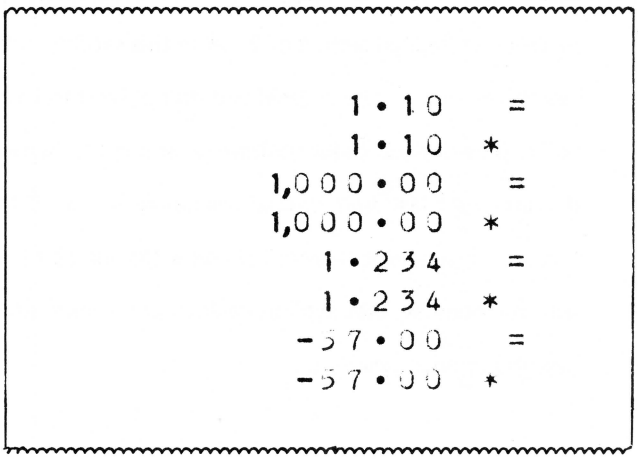
- The decimal point is shifted left as required to show all significant digits.
- The decimal point is shifted right as required to include the most significant digits.

Examples. With the AUTO/ROUND switch set to AUTO, enter a decimal point setting of two; enter various numbers and cause each one to be printed by depressing = . Change the decimal point setting to nine; enter and print various entries.

Depress:







SET D.P. 9

1 2 3 4 5 6 7 8 .

0 0 0 0 0

=

. 6 6 6 6 6 6 6 6

6 6 6 7 =

```
12,345,678.00000   =
12,345,678.00000   *
 .666666666667     =
 .666666666667     *
```

When you set this switch to ROUND, numbers printed in response to =, *, and *( ) are rounded to the SET D.P. position. All other numbers are printed to full significance. After rounding, the rounded number is retained in the E-register for further calculation.

Examples. With the AUTO/ROUND switch set to ROUND, enter a decimal point setting of two; enter various numbers and cause each one to be printed by depressing =. Change the decimal point setting to nine; enter and print some additional entries. Depress:

SET D.P. 2

1 . 1 0 1 3 5 =

4 . 2 3 6 =

SET D.P. 9

9 1 . 6 6 6 =

1 2 3 4 5 6 7 8 9 1

. 6 6 6 =

```
      1.10135   =
         1.10   *
        4.236   =
         4.24   *
91.666000000    =
91.666000000    *
1,234,567,891.666   =
1,234,567,891.666   *
```

(Unless specifically noted otherwise, all following examples in this manual assume this switch is set to AUTO.)

DATA ACCURACY

The calculator prints a maximum of 13 digits. For most operations the results are accurate to the thirteenth digit. However,

some functions are performed with numerical approximation techniques, changing the accuracy slightly. The calculations performed have the following minimum accuracies:

Function	Accuracy
Add	13 digits
Subtract	13 digits
Multiply	13 digits, rounded to 13th digit
Divide	13 digits, rounded to 13th digit

ERROR AND OVERFLOW

The calculator detects error and overflow conditions and prints an appropriate message.

Error

An error condition occurs when you try to perform operations that are illegal, such as:

- Divide by zero
- Enter more than 13 digits or enter a decimal point followed by more than 12 digits
- Depress two or more keys simultaneously
- Depress more than three keys sequentially without waiting for the previous function to be performed

The error condition causes the word ERROR to be printed (regardless of the position of the

switch), the calculator operation is halted with the keyboard inoperative, and the idle light flashes. Recovery from the error condition is described below.

Overflow

Overflow occurs when you attempt to perform operations with numbers that are outside the range of the calculator, such as:

- Generate a number that has an exponent greater than +99
- Generate a number that has an exponent less than −99

In these cases, the overflow condition causes the word OVERFLOW to be printed (regardless of the position of the PRINT switch), the calculator operation is halted with the keyboard inoperative, and the idle light flashes.

Overflow also occurs when you attempt to print numbers with more than 13 digits. In this case, although OVERFLOW is printed, the calculator operation is not stopped, and the idle light does not flash.

Recovery From Overflow or Error

When you cause an overflow or error condition (other than the last overflow described above), the calculator stops operation and the keyboard becomes inoperative except for the RESET and CLEAR ENTRY keys. Either key may be used to clear the overflow or error condition.

ARITHMETIC OPERATIONS

You can do either arithmetic or algebraic operations on your calculator – and do them independently. For example, you can start to add a group of numbers, solve a multiplication problem, and then continue the addition. The calculator performs the basic arithmetic operations of addition and subtraction by using a special register called the accumulator.

Adds the contents of the E-register to the contents of the accumulator. Repeated additions of the same number can be performed by depressing this key for each desired addition. The contents of the E-register are printed, followed by a + sign.

Subtracts the contents of the E-register from the contents of the accumulator. Repeated subtractions of the same number can be performed by depressing this key for each desired subtraction. The contents of the E-register are printed in red, followed by a – sign.

Recalls the subtotal from the accumulator to the E-register. Prints the subtotal, followed by a ◊ symbol. The subtotal is retained in the accumulator for additional operations.

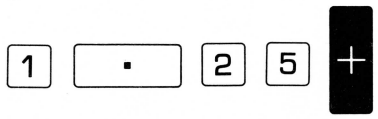
Used to print the total of additions and/or subtractions. Transfers the value in the accumulator to the E-register. The contents of the E-register are printed, followed by an * symbol. The result remains in the E-register and can be used for further calculations. The accumulator is then cleared.

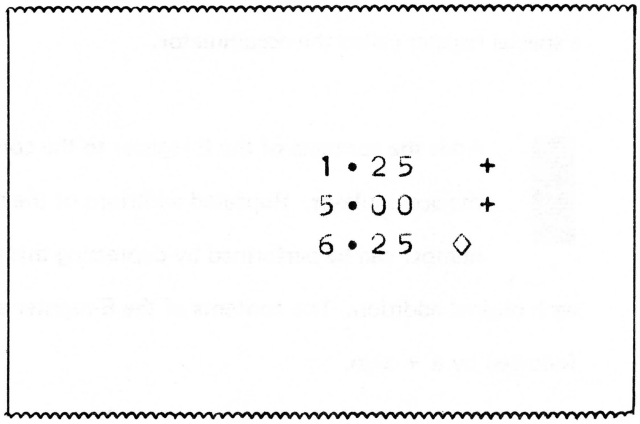
Examples.

1. Perform the following:

	1.25
	+5.00
Subtotal	6.25
	–3.75
Total	2.50

Depress:





3 . 7 5 −

2 . 5 0 *

2. Perform the calculation:

$8 - 7 - 2 = -1$

Depress:

8 + (Note: 8 + adds 8 into the accumulator.)

7 −

2 −

*

8 . 0 0 +

7 . 0 0 −

2 . 0 0 −

−1 . 0 0 *

A number may be added (or subtracted) repeatedly by simply depressing the operation key repeatedly.

Example. Perform the following:

$2 + 2 + 2 + 2 = 8$

Depress:

2 +

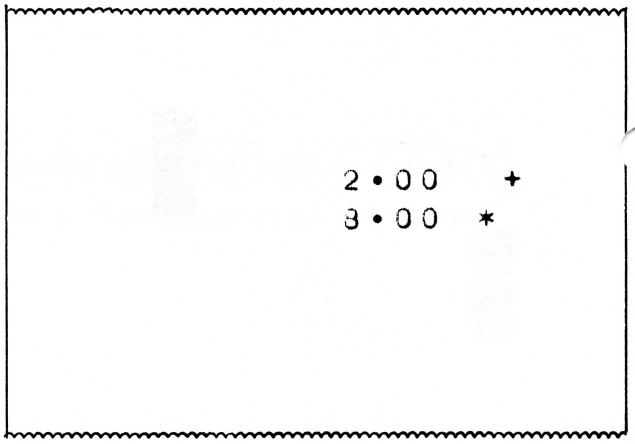
+

+

2 . 0 0 +

2 . 0 0 +

2 . 0 0 +



ALGEBRAIC OPERATIONS

The basic algebraic operations are multiply and divide.

× Prepares the calculator to multiply the number in the E-register by the next data entry. Chain calculations of multiplication and division are described in the Special Operating Techniques section.

÷ Prepares the calculator to divide the number in the E-register by the next data entry.

= Terminates the last data entry and executes the algebraic operation. Prints the entry, followed by an = symbol, and the result, followed by an * symbol.

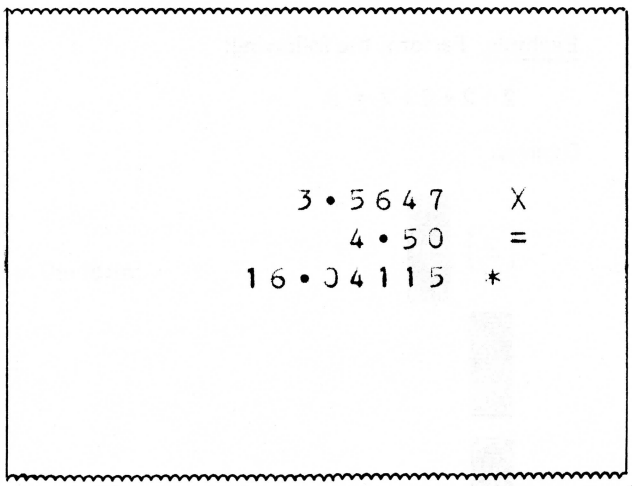
Examples.

1. Perform the following:

   3.5647 x 4.5 = 16.04

Depress:

3 . 5 6 4 7 ×
4 . 5 =



2. Perform the following:

$24 \div 3 = 8$

Depress:

2 4 ÷
3 =

```
24.00   ÷
 3.00   =
 8.00   *
```

To multiply a series of three or more numbers, you simply enter the numbers and the operators in sequence and terminate the operation with an = .

Example. Perform the following:

$4 \times 3 \times (-2) \times 5 = -120$

Depress:

4 ×
3 ×
2 CHG SIGN ×
5 =

```
  4.00   X
  3.00   X
 -2.00   X
  5.00   =
-120.00  *
```

To divide a series of three or more numbers, you simply enter the numbers and operators in sequence and terminate the operation with an = .

Example. $15 \div (-3) \div 1.25 = -4$

Depress:

1 5 ÷
CHG SIGN 3 ÷
1 . 2 5 =

```
 15.00   ÷
 -3.00   ÷
  1.25   =
 -4.00   *
```

MIXING ARITHMETIC AND ALGEBRAIC OPERATIONS

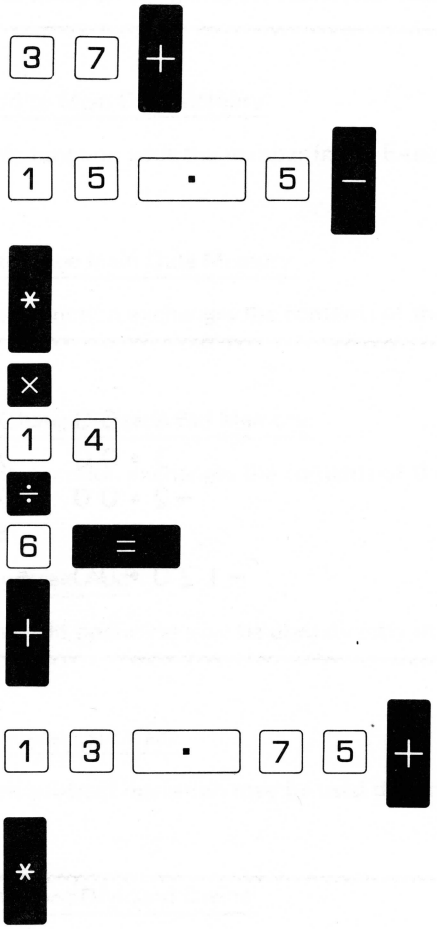
The arithmetic keys (+ , − , ◊ , *) and the algebraic keys (× , ÷ , =) may be used together in solving

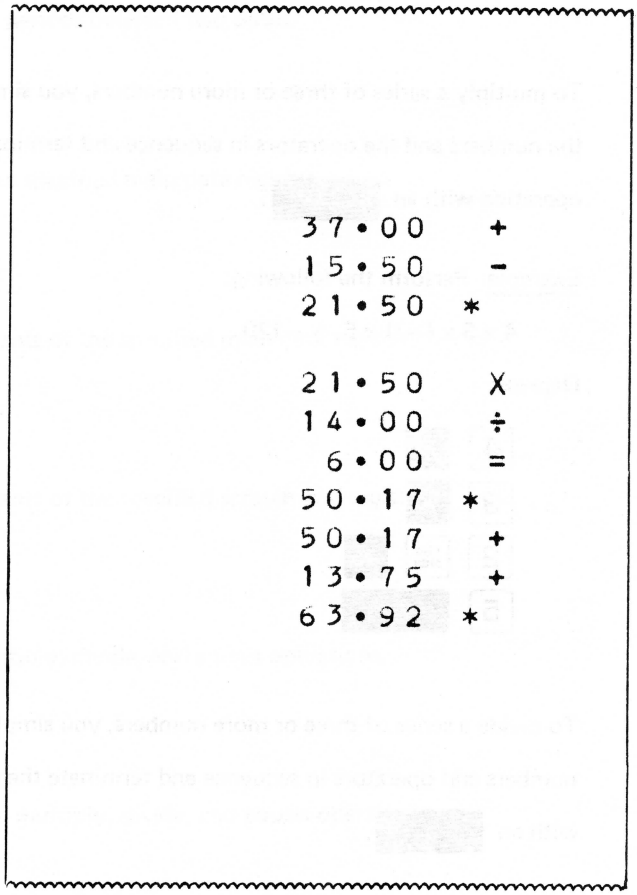
problems. The following example illustrates the combined use of these functions.

Example. Perform the following:

$$\frac{(37 - 15.5)\ 14}{6} + 13.75 = 63.92$$

Depress:





DATA STORAGE AND MANIPULATION

You will find that the calculator's ten scratch pad registers are useful for storing constants for future use, accumulating totals, storing intermediate results during complex operations, and performing various arithmetic operations. With a touch of two keys, you can store data into a scratch pad register, add to its contents, or recall subtotals or totals. These registers are numbered 0 through 9.

If you require additional storage space, the calculator has 64 additional registers referred to as main data registers. The calculator may have up to 512 of these data registers as an option. (See Appendix B.) The registers are numbered 00 through 511.

Scratch Pad Registers

The four scratch pad register operations are as follows:

[↓( )] Store data from the E-register into a scratch pad register. (Previous contents of scratch pad register are erased.)

[+( )] Add data from the E-register to the contents of a scratch pad register.

[◇( )] Recall subtotal from a scratch pad register. (Contents of scratch pad register are unchanged.)

[*( )] Recall total from a scratch pad register. (Scratch pad register is reset to zero after total is moved to E-register.)

The procedure in scratch pad register operations is to depress the key for the desired operation and then the numeral key ([0] through [9]) for the scratch pad register.

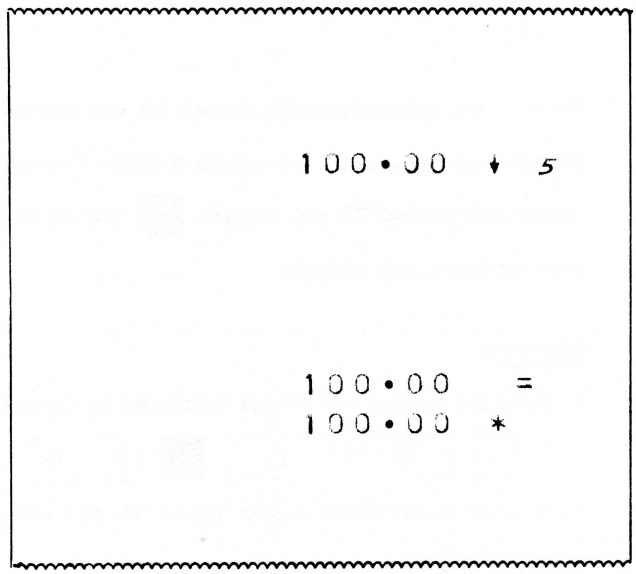
Examples.

1. Store the number 100 in scratch pad register 5. Depress:

[1] [0] [0] [↓( )] [5]

Your entry is now stored in register 5. It also remains in the E-register and can be used for further calculations. You can see this by depressing:

[=]



2. Now add 50 to the amount stored in scratch pad register 5.

Depress:

[5] [0] [+()] [5]

Then recall the subtotal by depressing:

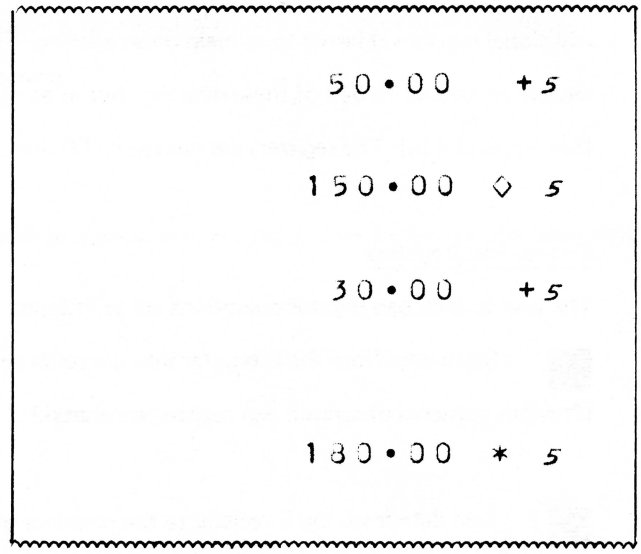
[◇()] [5]

Add 30 to scratch pad register 5. Depress:

[3] [0] [+()] [5]

Recall the total. This operation resets scratch pad register 5 to zero. Depress:

[*()] [5]



Data Registers

Data can be stored in and retrieved from the data registers in the same manner as the scratch pad registers. However, you can have up to 512 registers to work with.

[↓00] [↑00] You select the operation you want by first depressing the [↓00] or [↑00] key and two numeral keys for registers 00 through 99, or a non-numeral key and two numeral keys for registers 100 through 299, as explained below. (Data registers 300 through 511 can be accessed using techniques discussed in the Model 1830 Programming Reference Manual under the subject, Main Data Memory Registers.)

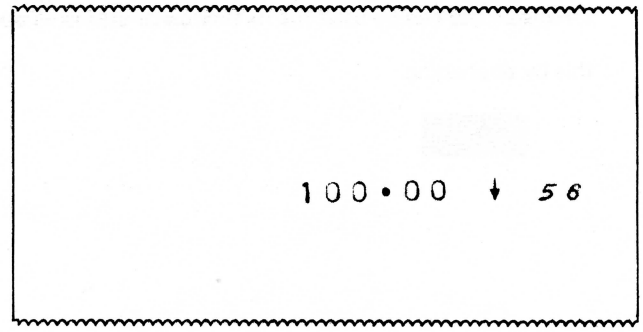
To store into data registers 00 through 99, you depress [↓00] and the two numeral keys for the register desired. To recall from data registers 00 through 99, you depress [↑00] and the two numeral keys for the register desired.

Examples.

1. Store the number 100 in data register 56 by depressing:

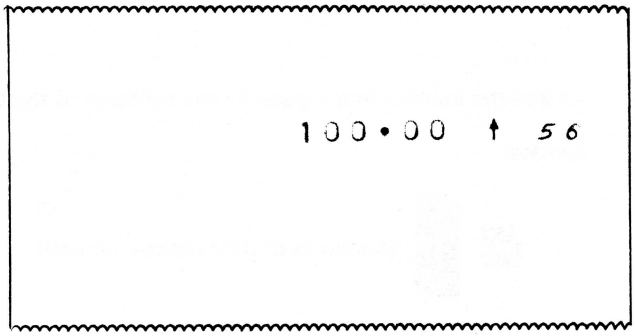
[1] [0] [0] [↓00] [5] [6]

Your entry is now stored in data register 56. It is also still in the E-register and can be used in further calculations.



2. Recall the number stored in data register 56. Depress:

[↓00] [5] [6]



If your calculator has more than 64 data registers, you need to depress additional keys to use registers 100 through 299. You use the [.] key before the two numeral keys for data registers 100 through 199 and the [CHG SIGN] key before the numeral keys for data registers 200 through 299.

Examples.

1. Store the number 100 in data register 156 by depressing:

[1] [0] [0] [↓00] [.] [5] [6]

You can recall the number from register 156 by depressing:

[↓00] [.] [5] [6]

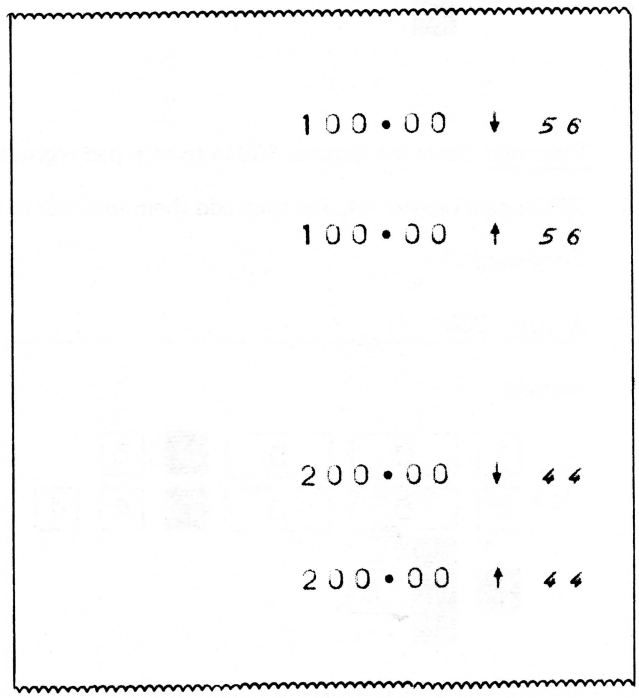
Care must be taken in interpreting the printout symbol, since ↑56 is printed for registers 56, 156, 256, and so forth.

2. Store the number 200 in register 244 by depressing:

[2] [0] [0] [↓00] [CHG SIGN] [4] [4]

You can recall the number from register 244 by depressing:

[↓00] [CHG SIGN] [4] [4]



Register Arithmetic

You can perform addition, subtraction, multiplication, or division with the contents of any of the scratch pad or data registers.

To add the number in the E-register to the contents of a register, depress:

[↓00] [+] (numerals of data register desired)

or

[+( )] (numeral of scratch pad register desired)

To add the number in a register to the contents of the E-register, depress:

[↓(00)] [+] (numerals of data register desired)

or

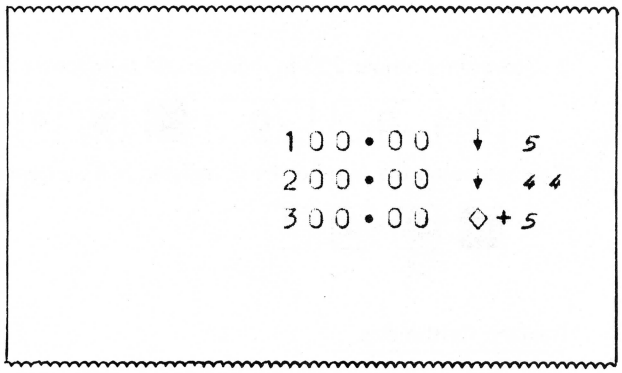
[◇( )] [+] (numeral of scratch pad register desired)

Example. Store the number 100 in scratch pad register 5, store 200 in data register 44, and then add them together in the E-register.

Answer. 300

Depress:

[1] [0] [0] [↓( )] [5]
[2] [0] [0] [↓(00)] [4] [4]
[◇( )] [+] [5]



To subtract the number in the E-register from the contents of a register, depress:

[↓(00)] [−] (numerals of data register desired)

or

[↓( )] [−] (numeral of scratch pad register desired)

To subtract the number in a register from the contents of the E-register, depress:

[↓00] [−] (numerals of data register desired)

or

[◇( )] [−] (numeral of scratch pad register desired)

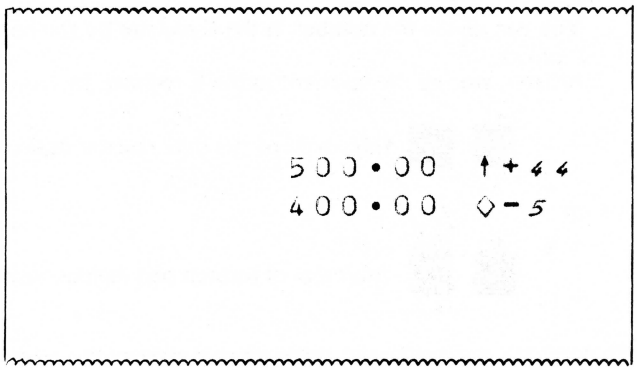
Example. Using the numbers stored in scratch pad register 5 and in data register 44 from the last example, enter the number 300 in the E-register, add 200, and subtract 100.

Answer. 400

Depress:

[3] [0] [0] [↓00] [+] [4] [4]

[◇( )] [−] [5]



You can multiply the number in a register by the contents of the E-register, storing the product in the register, by depressing:

[↓00] [×] (numerals of data register desired)

or

[↓( )] [×] (numeral of scratch pad register desired)

You can multiply the number in the E-register by the contents of any register, storing the product in the E-register, by depressing:

[↓00] [×] (numerals of data register desired)

or

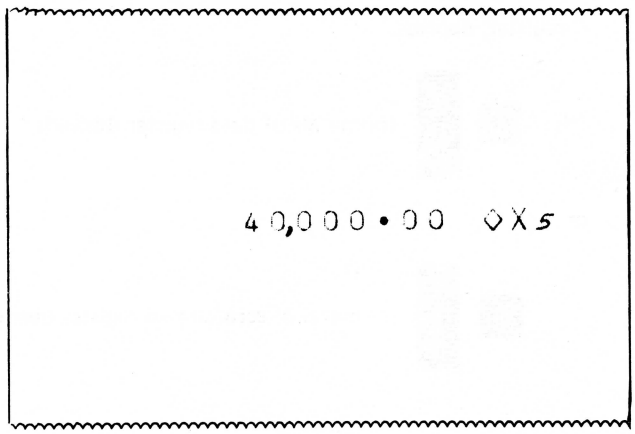
[◇( )] [×] (numeral of scratch pad register desired)

Example. With the number 400 still in the E-register, multiply this number by the contents of scratch pad register 5 (100).

Answer. 40,000

Depress:

◇() × 5



You can divide the number in the E-register into a number in any register, storing the quotient in that register, by depressing:

↓00 ÷ (numerals of the data register desired)

or

↓() ÷ (numeral of scratch pad register desired)

You can divide the number in the E-register by the contents of any register, storing the quotient in the E-register, by depressing:

↑00 ÷ (numerals of the data register desired)

or

◇() ÷ (numeral of scratch pad register desired)

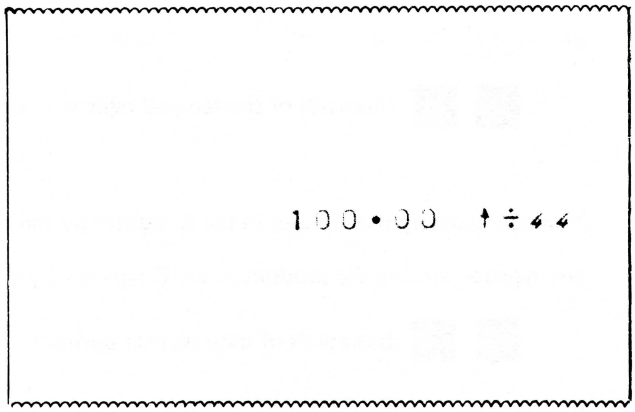
Example. Divide the number 20,000 in the E-register by the contents of data register 44. (The number 200 remains stored in data register 44, from the previous example.)

Answer. 100

Depress:

2 0 0 0 0

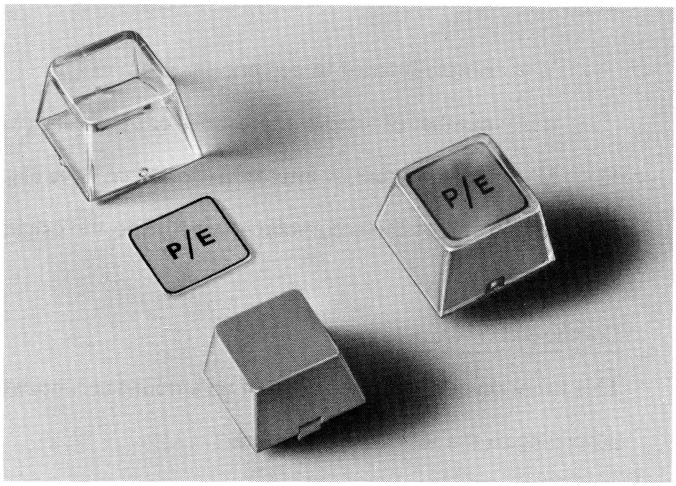
↑00 ÷ 4 4



USER-DEFINABLE KEYS

The keyboard of the Model 1830 contains 13 blank keys. These keys may be used to access certain functions provided with the calculator, such as simple or compound interest, or functions and calculational procedures that you prepare yourself. Examples of the use of these keys with prepared programs are presented in the AUTOMATIC OPERATION section. The details of programming for these function keys are discussed in the Model 1830 Programming Reference Manual.

Transparent key caps and labels that fit the blank keys are provided so that you may label each key according to the function it performs. For example, if a key, when depressed, addresses a program for calculating price-to-earnings ratio, the key might be labeled [P/E]. You prepare the label, put it in place, then press the transparent cap into place over it, as shown to the right. Align the two bumps at the bottom edge of the transparent cap to snap into the corresponding notches on the key.



When you depress this key, followed by one of twelve keys (numerals [0] through [9], [.], or [CHG SIGN]), you can access certain functions provided with the calculator, such as simple or compound interest, or functions and programs that you prepare yourself, in a manner similar to the use of the blank keys. You will find details of programming for this special function key in the Model 1830 Programming Reference Manual. The use of this key with a prepared program is illustrated in the AUTOMATIC OPERATION section.

PERMANENTLY STORED FUNCTIONS AND COMMANDS

The following functions and commands are permanently stored in the Model 1830. They cannot be accessed directly from the keyboard, but are available for use in programs provided to you, or prepared by you. When correctly programmed, these functions

are accessible through the user-definable keys. These functions are listed and discussed briefly here, with defining equations in some cases; they are covered in greater detail in the Model 1830 Programming Reference Manual. The use of several of these functions is shown in the AUTOMATIC OPERATION section of this manual.

Simple Interest

This function calculates the ratio of an amount accumulated to an original amount at simple interest over a given period, according to the following equation:

$$S = \left(1 + \frac{r_s}{100}\frac{M}{q}\right)$$

where

r_s = simple interest in percent per year

q = number of simple interest periods per year (for example, interest paid quarterly would be expressed by q = 4)

M = total number of interest periods that have elapsed

S = ratio of the accumulated amount to the original amount

Compound Interest

This function calculates the ratio of an amount accumulated to an original amount at compound interest over a given period, according to the following equation:

$$C = \left(1 + \frac{r_c}{100q}\right)^M$$

where

r_c = compound interest rate in percent per year

q = number of compound interest periods per year

M = total number of compound interest periods

C = ratio of the accumulated amount to the original amount

Compound Rate

This function calculates the compound interest rate necessary to bring about a specified ratio of accumulated amount to original amount after a given period, according to the following equation:

$$r_c = 100q\left(R^{1/M} - 1\right)$$

where

q = number of interest compounding periods per year

R = ratio of final accumulated amount to original amount

M = total number of interest compounding periods

r_c = compound interest rate

Annuity

This function is used to calculate the future or present value of an annuity, according to the following equation:

$$A = \left| \frac{\left(1 + \frac{r_c}{100q}\right)^M - 1}{\frac{r_c}{100q}} \right|$$

where

r_c = compound interest rate in percent per year

q = number of interest compounding periods per year

M = total number of interest compounding periods

When M is positive, A represents the future value of an annuity.

When M is negative, A represents the present value of an annuity.

Calendar 1 and Calendar 2

Either Calendar 1 or Calendar 2 can be used to calculate the number of days from a reference date (March 1, 1900) to a date that you enter. The number of days is calculated using the actual calendar as a basis (including leap years), and also using bases of 360 and 372 days per year.

The results of the Calendar 1 and Calendar 2 functions can be subtracted to find the number of days between two dates, using the actual calendar, the 360-day or the 372-day bases.

Print Date

This function causes a number in the E-register having the form MM.DDYY to be printed in the format MM-DD-YY, where MM represents the number of the month, DD the day of the month, and YY the last two digits of the year.

Coupon Periods

This function calculates the number of whole and fractional coupon periods between two dates.

Add to Main Data Memory

This function adds the number in the E-register to the contents of the specified main data register.

Exchange Main Data Memory

This function exchanges the contents of the E-register with the contents of the specified main data register.

Exchange Scratch Pad Memory

This function exchanges the contents of the E-register with the contents of the specified scratch pad register.

Algebraic Add

This add operation may be used directly in conjunction with the multiply, divide, and equals operations.

Algebraic Subtract

This subtract operation may be used directly in conjunction with the multiply, divide, and equals operations.

Constant-Dividend Divide

This function may be used to simplify repeated division using a constant dividend.

Open and Close Parentheses

These functions may be used in algebraic calculations to indicate the grouping of operations, as in the expression:

$$(2 + 3) \times (4 + 5) = 45$$

Absolute Value

This function obtains the absolute value of a number.

Equals Sum-Zero

This function performs exactly as [=] does, and the calculated result is added to scratch pad register 0.

Increment Entry

This function adds 1 to the contents of the E-register.

Decrement Entry

This function subtracts 1 from the contents of the E-register.

Square

This function calculates the square of the number in the E-register.

Square Root

This function calculates the square root of the number in the E-register.

Raise to Power

This function raises the number in the E-register to the power specified.

Invert

This function inverts the number in the E-register.

Logarithm

This function calculates the logarithm to the base 10 and the base *e* of the number in the E-register.

Antilogarithm

This function calculates the antilogarithm to the base 10 and the base *e* of the number in the E-register.

Integer, Fraction

This function separates the number in the E-register into its integer and fractional portions.

Second Function

Some functions, such as the logarithm, calculate two quantities. One of the quantities is printed and left in the E-register; the other is stored in a separate register. Second Function may be used to exchange the contents of the E-register with that separate register.

Print Disable

This function disables printing from a user program. Printing in response to keyboard operations is not affected.

Print Enable

This function enables printing from a user program.

Dot Print

This function causes a line of dots to be printed.

Red Dot Print

This function causes a line of red dots to be printed.

Print Entry

This function prints the number in the E-register.

Print Answer

This function rounds the number in the E-register to the current decimal place setting and prints the rounded number.

Recall Decimal Point

This function recalls the previous decimal point setting.

Exponent

This function is used to define an exponent when a number is being expressed in the form:

$$a \times 10^{b}$$

π, e Constants

This function enters the constant π in the E-register and the constant e in the second function register.

Roundoff

This function causes the number in the E-register to be rounded to the current decimal place setting. Thus, with a decimal place setting of 2, 3.456 is rounded to 3.46.

Roundup

This function causes the number in the E-register to be rounded to the next higher numeral in the last place specified by the decimal point setting. Thus, with a decimal place setting of 2, 3.432 is rounded up to 3.44.

Truncate

This function causes the number in the E-register to be truncated at the last place specified by the current decimal place setting. Thus, with a decimal place setting of 2, 3.456 is truncated to 3.45.

Identifier

This function causes the contents of the E-register to be printed in a left-justified format with trailing zeros suppressed, to create numeric identifiers.

SPECIAL OPERATING TECHNIQUES

Now that you have become familiar with each key described in the preceding sections, you can perform many other operations on the calculator by using combinations of these keys and combinations of the operations you have already performed.

The following special operating techniques enable you to use the various capabilities of the calculator. They also demonstrate some of the calculator features you should remember when performing these various operations.

ALGEBRAIC CHAINING

You can use any algebraic key instead of the equals key to terminate a previous algebraic operation and begin a new algebraic operation.

Example. Perform the following equation:

$2 \times 3 \div 4 \times 5 = 7.50$

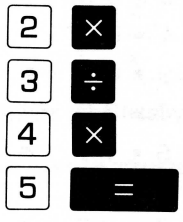
This is equivalent to:

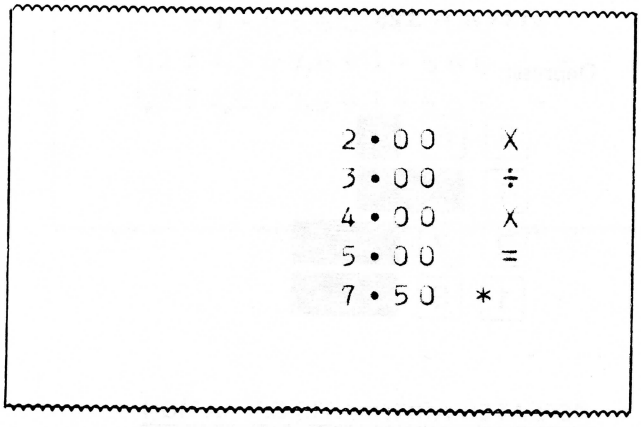
$2 \times 3 = 6$

$6 \div 4 = 1.50$

$1.50 \times 5 = 7.50$

Depress:





MULTIPLICATION BY A CONSTANT

During multiplication, the calculator retains the multiplier so you can perform repeated multiplications without reentering the

multiplier. Simply enter the new number to be multiplied, followed by [=].

Example. Perform the following:

.75 x 7 = 5.25

.75 x 10.5 = 7.875

.75 x 30 = 22.50

Depress:

[.] [7] [5] [×]
[7] [=]
[1] [0] [.] [5] [=]
[3] [0] [=]

```
      .75   X
     7.00   =
     5.25   *
    10.50   =
     7.875  *
    30.00   =
    22.50   *
```

DIVISION BY A CONSTANT

During division, the calculator retains the divisor so you can perform repeated division without reentering the divisor. Simply enter the new number to be divided (dividend), followed by [=].

Example. Perform the following:

36 ÷ 4 = 9

27 ÷ 4 = 6.75

13 ÷ 4 = 3.25

Depress:

[3] [6] [÷]
[4] [=]
[2] [7] [=]
[1] [3] [=]

```
     36.00   ÷
      4.00   =
      9.00   *
     27.00   =
      6.75   *
     13.00   =
      3.25   *
```

REPEATED ARITHMETIC OPERATION

You can repeat an addition operation by depressing the [+] key for each repetition.

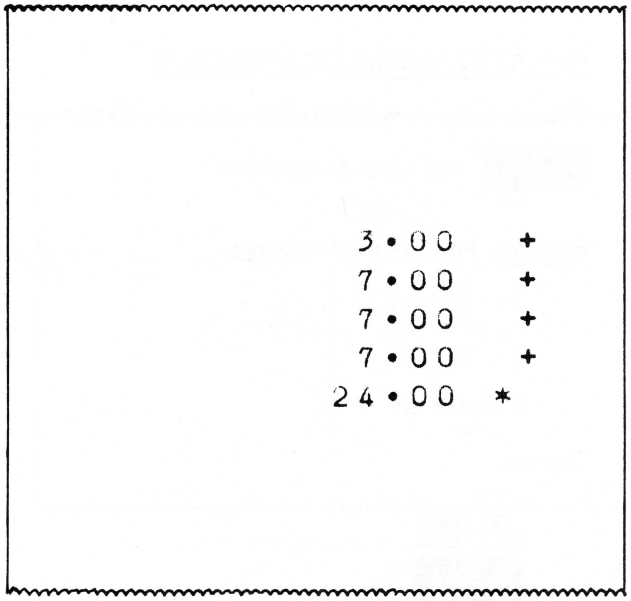
Example. Perform the following:

3 + 7 = 10

10 + 7 = 17

17 + 7 = 24

Depress:



Similarly, you can repeat a subtraction operation by depressing the — key for each repetition.

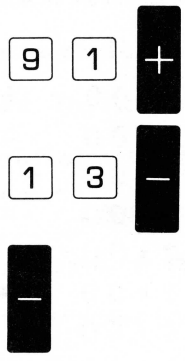
Example. Perform the following:

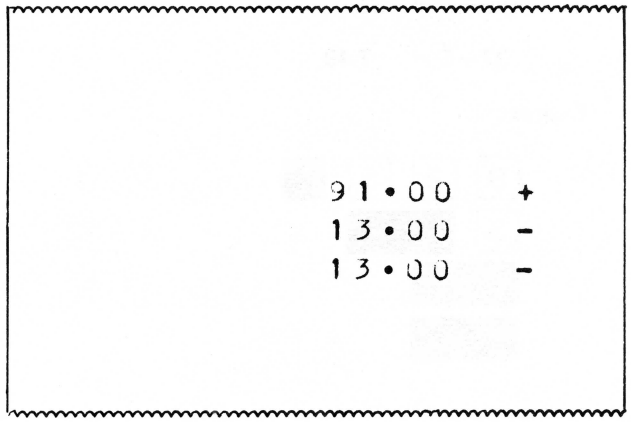
91 – 13 = 78

78 – 13 = 65

65 – 13 = 52

Depress:





```
13.00   -
52.00   *
```

REPEATED ALGEBRAIC OPERATION

You can repeat a multiplication operation by depressing the

key for each repetition.

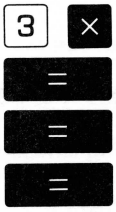
Example. Perform the following:

3 x 3 = 9

3 x 9 = 27

3 x 27 = 81

Depress:



```
 3.00   X
 3.00   =
 9.00   *
 9.00   =
27.00   *
27.00   =
81.00   *
```

You can repeat a division being performed by depressing the

key for each repetition.

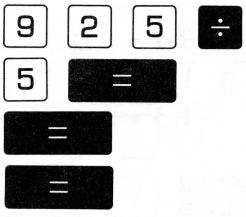
Example. Perform the following:

925 ÷ 5 = 185

185 ÷ 5 = 37

37 ÷ 5 = 7.40

Depress:



```
925.00   ÷
  5.00   =
185.00   *
185.00   =
 37.00   *
 37.00   =
  7.40   *
```

DOUBLING AND SQUARING NUMBERS

As a special case of repeated addition, a number in the accumulator can be doubled by repeatedly using the [+] and [◊] keys.

Example. Perform the following:

3 + 3 = 6

6 + 6 = 12

12 + 12 = 24

Depress:

[3] [+] [+] [◊] [+] [◊] [+] [*]

```
3.00   +
3.00   +
6.00   ◊
6.00   +
12.00  ◊
12.00  +
24.00  *
```

A number can be squared repeatedly by using the [×] and [=] keys in succession.

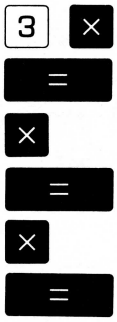
Example. Perform the following:

3 x 3 = 9

9 x 9 = 81

81 x 81 = 6,561

Depress:



```
        3.00   X
        3.00   =
        9.00   *
        9.00   X
        9.00   =
       81.00   *
       81.00   X
       81.00   =
    6,561.00   *
```

AUTOMATIC OPERATION

Though all the calculator keys that are used for manual operation have been discussed, some keys on the calculator still have not been mentioned. Those keys, which are used for automatic operation of the calculator, will be discussed in this section. Other keys, used only by programmers, are covered in the Model 1830 Programming Reference Manual.

Each operation you perform to solve a problem is referred to as an instruction. The instruction tells the calculator what to do. The series of instructions required to solve the problem is called a program. The program is stored in the calculator in an area called the memory. Each instruction takes up one or more steps in the memory.

The basic memory has 512 steps, but calculator memory may be expanded to 4096 steps. The steps are numbered sequentially, starting from step 0 and going up to step 4095. Each tenth step is called a branch point, and a program may be started at any branch point.

Before going further, review what has already been covered. Each operation you want the calculator to perform is an instruction. For example, in the following problem:

$(2 + 4) \times 6 = 36$

+ is an instruction, x is an instruction, and = is an instruction. The number 36 is the result or answer. The numbers 2, 4, and 6 may be changed each time you perform the problem. They may be symbolized by x, y, and z, representing variables, in the problem. These variables are entered manually from the keyboard, so the calculator must stop when each number is to be entered. This is done by placing a Halt instruction in the program where a variable is to be entered.

You may not be writing any programs yourself, but you probably will be loading programs into the calculator and running them (executing programs). You should, therefore, be familiar with the terms program, memory, step, branch point, and variable when you see them. For an introduction to the basic concepts and definitions of programming, you may refer to Fundamentals of Programming.

SELECTING A BRANCH POINT

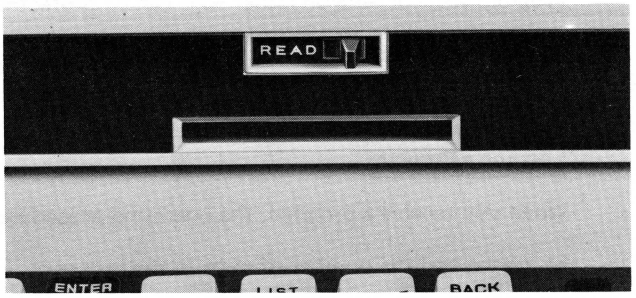
When you receive a program, the branch point where the program is to be loaded will be indicated on the program operating procedure sheet. (The number of steps in the program will be indicated, as well as other information needed for the specific program.)

Branch points are selected by depressing the BRANCH key and the data entry keys (numeral keys) corresponding to the desired branch point. Branch points 0 through 299 are addressed as shown in the following table. Note that for branch points 100 through 199, the . key is used instead of the 1 for designating the first digit. Similarly, for branch points 200 through 299, the CHG SIGN key is used. (Branch points 300 to 409 can be addressed only through special techniques, discussed in the Programming Reference Manual.)

Keys	Step No.	Branch Point
0 0	0	0
0 1	10	1
0 2	20	2
0 3	30	3
0 4	40	4
0 5	50	5
0 6	60	6
0 7	70	7
0 8	80	8
0 9	90	9
1 0	100	10
1 1	110	11
.	.	.
.	.	.
.	.	.
9 9	990	99

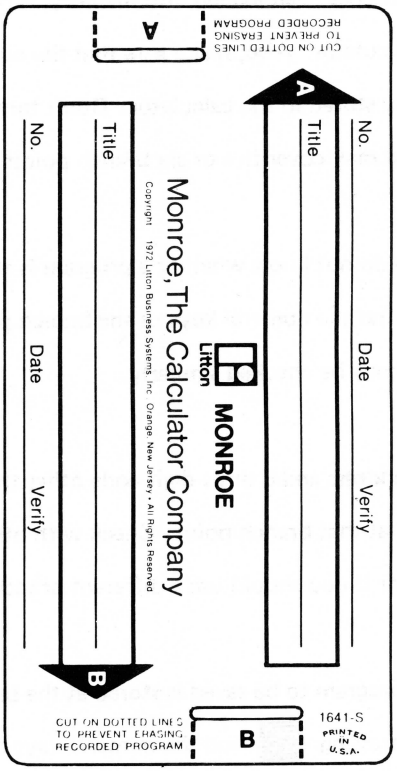
Keys	Step No.	Branch Point
. 0 0	1000	100
. 0 1	1010	101
. 0 2	1020	102
. 0 3	1030	103
. 0 4	1040	104
. 0 5	1050	105
. 0 6	1060	106
. 0 7	1070	107
. 0 8	1080	108
. 0 9	1090	109
. 1 0	1100	110
. 1 1	1110	111
.	.	.
.	.	.
.	.	.
. 9 9	1990	199
CHG SIGN 0 0	2000	200
CHG SIGN 0 1	2010	201
CHG SIGN 0 2	2020	202
CHG SIGN 0 3	2030	203
CHG SIGN 0 4	2040	204
.	.	.
.	.	.
.	.	.
CHG SIGN 9 9	2990	299

INTEGRAL MAGNETIC CARD DEVICE



In the upper central portion of the calculator are a slot and a switch with the words READ and WRITE. This is the integral magnetic card device. All programs on magnetic cards use this device.

The top side of the card has preprinted information as illustrated at the right. The bottom side of the card has a magnetic coating and a protective coating. The latter protects the card against the effects of excessive handling.



You should know certain things about handling the cards before you use them:

- Cards should not be stacked with their magnetic surfaces touching.
- Cards should be protected from high magnetic fields.
- Cards should not become contaminated with dust or surface coatings, especially on the magnetic surface. The magnetic surface can be cleaned with plain water.
- Cards should not be "folded, mutilated, or spindled."
- Cards should be stored in their envelopes when not being used.
- A magnetic cleaning card (# 1674-S), to be used once a month, is available for your calculator. Its purpose is to clean the read/write head of the magnetic card device. Full instructions for its use are written on the card.

Instructions can be recorded on both the A and B edges of the card. Each edge (A and B) can hold up to 256 steps or a total of 512 steps on both edges. Also, the card can be used to load data into the main data registers. Each edge of the card can hold data for up to 32 data registers, or a total of 64 data registers on both edges.

Program steps or data on either edge can be protected by cutting the corresponding dotted portion on the edge of the card, and removing the tab. In this way, a program cannot be written over inadvertently with a new program.

Loading a Program

When you receive a program, the operating procedure sheet accompanying the program will indicate where the program is to be loaded and the number of steps in the program.

Before you load the program, make sure that a program to be saved is not already stored in that portion of memory. Once a program has been loaded into memory, it remains there until either a new program is written over it or power is removed from the calculator. Also, make sure that the number of steps in the program you are to load will not run into another program already stored in the calculator. Don't forget, a program can be started at any branch point, and the program you are going to load may cover five or six branch points.

If you do not know whether a program is stored at your starting branch point, you can check for it very simply by depressing [BRANCH 0 0] and the numeral keys of the branch point you are to use. Then depress [LIST PROG]. Other branch points within your program range may be checked similarly.

If an address and a three-digit code other than 377 (which is the no operation code) are printed on the tape, a program is stored at that branch point. Check with other individuals using the calculator to see if you can load over the program stored there or if you should use a different branch point.

If no program to be saved is stored at the branch point or other branch points within you program range, load your program by depressing [BRANCH 0 0] and the numeral keys of the branch point you are to use, making sure that the RUN/STEP/LOAD switch is on RUN.

Make sure that the switch over the slot on the card device is set to READ.

Insert the A edge of the card into the slot on the card device. The card will be pulled into the card device and then ejected. If the other edge of the card is to be loaded, turn the card around and insert the B edge into the card device slot. Load any additional cards the same way.

After the cards have been loaded, replace the cards in their protective envelopes.

After you have loaded the program, the word ERROR may be printed on the printer tape, and the idle light may flash. This means that an error may have been made during the loading of the program and that the cards should be fed through again.

Before you feed the cards through, depress [RESET] . This clears the error condition and allows you to start the loading procedure again. If ERROR still occurs, it may indicate a scratched or otherwise damaged card.

Loading Data

The program may require data in a group of data registers. You can load data from magnetic cards into the main data registers as follows:

- Depress [↓00] and the numeral keys of the first data register to be used.
- Make sure that the switch on the card device is set to READ.
- Feed the card through the card device in the same manner as loading instructions.

If the word ERROR prints and the idle light flashes, depress [RESET] and load the cards again.

Executing a Program

After you have completed loading the program and data, you can begin executing the program in one of two ways, depending on how the program was prepared. The program operating procedure sheet will indicate which procedure to use.

One way of starting a program, if so indicated, is to depress [BRANCH 0 0] and the numeral keys of the branch point where the program begins. The switch on the card device can be in either the READ or WRITE position. Then depress [RESUME] . If you are going to begin executing the program immediately after you have loaded it and you have not loaded data after the program, you do not need to depress [BRANCH 0 0] ; you can begin executing the program merely by depressing the [RESUME] key.

A second way of starting a program, if indicated on the operating procedure sheet, is to enter the first data entry from the keyboard and then depress a specified user-definable key (blank or [□]), which may be labeled the Start Key. If data entry is not required at this point, you simply depress the designated user-definable key (Start Key).

With either procedure, the calculator will begin executing the program and continue until it reaches the first Halt instruction. This is usually a point where you are to make a manual entry of a variable from the keyboard. An identifying code, such as:

2 . . . . . .

is printed at this point and the calculator then stops. The instructions you received on the program operating procedure sheet should tell you what manual entries to make and what the identifying code is for each entry. You then enter the variable from the keyboard and depress the [RESUME] key or a designated user-definable key, whichever is called for, to continue the program. Each time the calculator reaches a Halt instruction in the program, it will print the identifier and then halt for you to make a manual entry. After you make the entry, depress the [RESUME] key or designated user-definable key to continue the program.

Your operating instructions with the program may tell you to set the SENSE switch at some point in the program where the calculator has halted. This switch is in the upper right portion of the calculator next to the RUN/STEP/LOAD switch. The instructions may also tell you to depress the [FLAG] key at some point in the program. This key is also in the top row of keys near the [BRANCH] key. These operations allow the program to make a decision as to which path of the program should be taken. After setting the SENSE switch or depressing the [FLAG] key, the [RESUME] key must be depressed to continue the program. Data may be entered and a switch set at a single Halt; refer to the specific operating procedure sheet.

Recording a Program Onto Magnetic Cards

You may be asked to record a program that has been manually stored in memory onto magnetic cards for a permanent program. Before you can record the program on cards, you must know where the program starts and the number of steps in the program. You can then record the program with the following procedure:

- Depress [BRANCH] and the numeral keys of the branch point where the program begins.
- Enter the number of steps in the program into the E-register by depressing the numeral keys for the number of steps.
- Set the card device switch to WRITE.
- Insert the A edge of the magnetic card into the card slot. The card will be pulled into the device and then ejected.
- If the program has more than 256 instructions (steps), insert the B edge of the card into the card slot to record the remainder of the program.
- If the program has more than 512 steps, insert the A edge of a second card into the card slot.
- Continue until the entire program has been recorded.
- After the program has been recorded, set the card device switch back to READ unless additional programs are to be recorded.

Recording Data Onto Magnetic Cards

You can record data from the main data registers onto magnetic cards in the same manner as you record a program. Before you begin, you must know which data register you want to start recording from and the number of data registers to be read. Then, use the following procedure:

- Depress [↑00] and the numeral keys of the first data register to be read.
- Enter into the E-register the number of registers to be read by depressing the numeral keys for the number of registers.
- Set the card device switch to WRITE.
- Insert the A edge of the magnetic card into the card slot.
- If more than 32 registers are to be recorded, insert the B edge of the card into the card slot to record the remainder of the registers.
- After all the registers have been recorded, reset the card device switch to READ unless additional cards are to be written.

NOTE: Data cannot be recorded from the scratch pad registers onto magnetic cards.

LABELING USER-DEFINABLE KEYS

Frequently, the operating procedure sheet that accompanies your program will show the user-definable keys to be used with that program. For example, you might be instructed to use certain keys as illustrated below.

The key designations are as follows:

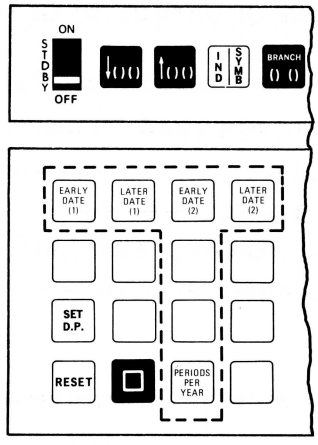
EARLY DATE (1)

LATER DATE (1)

EARLY DATE (2)

LATER DATE (2)

PERIODS PER YEAR



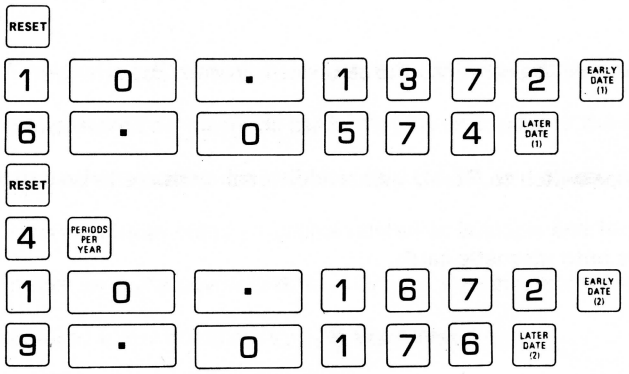
You could then label the keys (see USER-DEFINABLE KEYS section) so that your Model 1830 keyboard would appear as shown in the accompanying figure.

USE OF USER-DEFINABLE KEYS

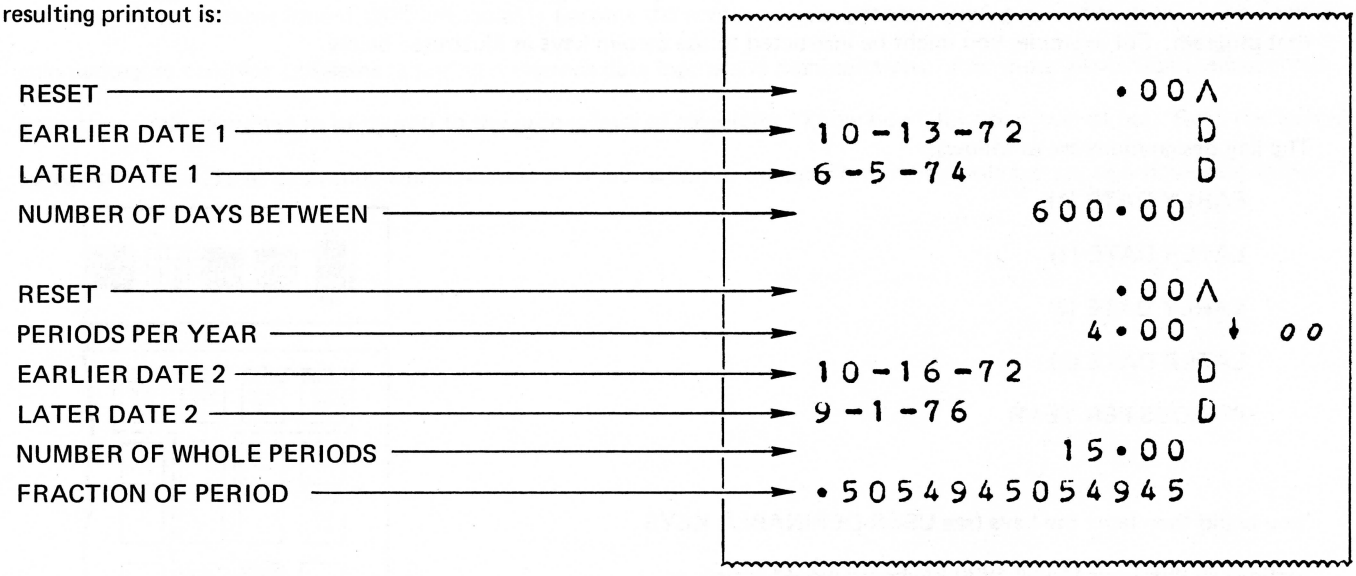
The use of the user-definable keys can be demonstrated by a sample program that calculates the number of days between two dates (in this example, October 13, 1972 and June 5, 1974).

The program also calculates the number of coupon periods and any fractional period between two dates (in this example, October 16, 1972 and September 1, 1976). Four coupon periods per year are assumed. (Details of this program are presented in the Model 1830 Programming Reference Manual.) Assume that we have entered this program from the keyboard or loaded it from magnetic cards as described earlier in this section. The key labels shown in the preceding figure are valid for this example.

Depress:



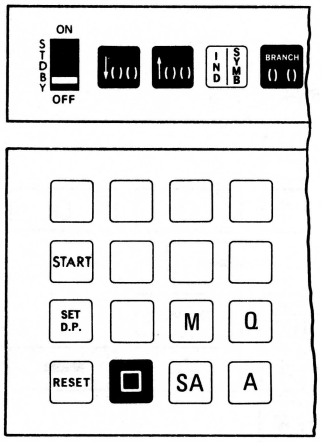
The resulting printout is:



An additional sample program uses the annuity function to calculate the amount of monthly, quarterly, semi-annual, or annual loan payments and total cost of a loan when the following information is known:

- the amount of the loan
- r_c, the compound interest rate
- the life of the loan, in years

After the program has been entered or loaded into the Model 1830, you carry out the following actions to execute the program (a detailed description of this program is presented in the Model 1830 Programming Reference Manual):



1. Press START key (see illustration to the right, showing how user-definable keys might be labeled for this program).

2. After the program prints a dotted line, you enter the amount of the loan from the keyboard.

3. Depress [RESUME]. The amount of the loan will be printed.

4. Enter the compound interest, in percent per year.

5. Depress [RESUME]. The compound interest rate will be printed.

6. Enter the life of the loan in years.

7. Depress [RESUME]. The life of the loan will be printed.

8. Enter the payment option, one of these four:
   - Depress [M] for monthly payments
   - Depress [Q] for quarterly payments
   - Depress [SA] for semi-annual payments
   - Depress [A] for annual payments

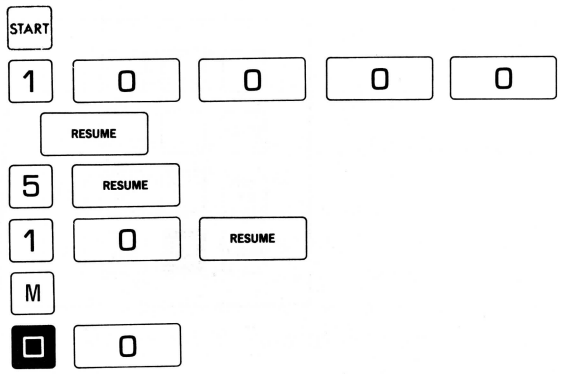
9. The payment will be calculated and printed.

10. Depress [□] [0] if you wish to obtain the total cost of the loan. (Optional) Otherwise, depress [START] to begin a new calculation cycle.

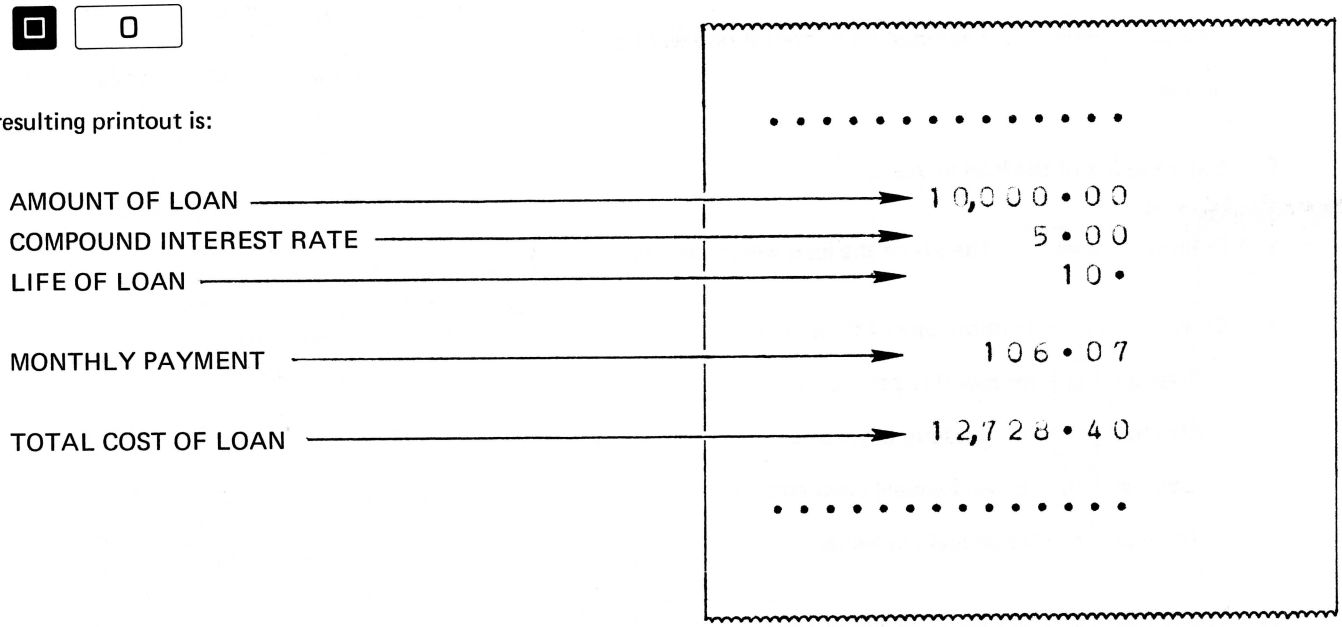
11. After the total cost of the loan has been printed (assuming you have depressed [□] [0]), the program prints a line of dots and is ready for the entry of a new loan amount.

For example, if the amount of a loan is $10,000, the compound interest rate is 5% and the life of the loan is 10 years, the monthly payment and total cost of the loan are calculated as follows:

Depress:



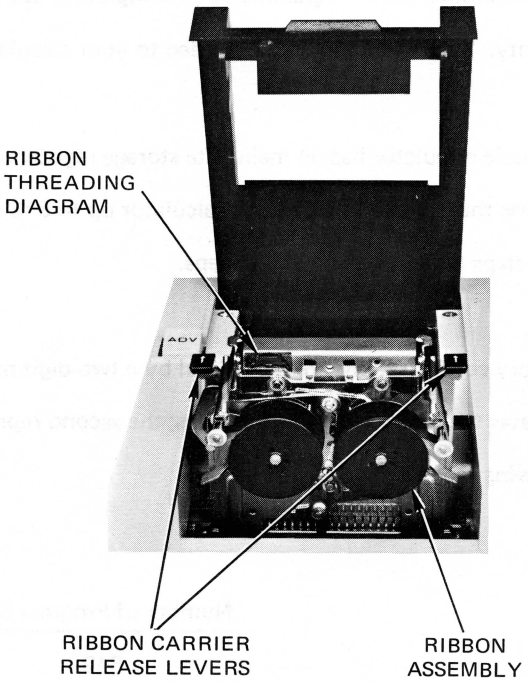
The resulting printout is:



APPENDIX A. RIBBON AND PAPER REPLACEMENT

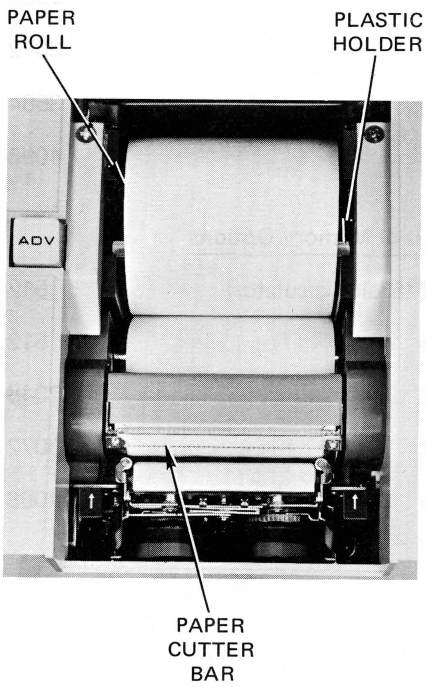
To replace the printer ribbon, proceed as follows:

- Open the printer cover on the calculator.
- Press ribbon carrier release levers in and raise ribbon housing above level of calculator cover.
- Press down ribbon reel retainers and remove both ribbon reels from carrier.
- Unwind ribbon from tension levers and ribbon guide plates.
- Remove ribbon from ribbon housing.
- Discard ribbon and replace with a Monroe black and red nylon ribbon. Do not replace with a cotton ribbon as the printing will be blurred.
- Unwind some ribbon from the new spools and start the ribbon from the back of the carrier. Make sure the black half of the ribbon is at the top.
- Draw ribbon over the ribbon guide plates.
- Twist ribbon over tension levers, press down ribbon reel retainers, and place reels on ribbon spool shafts.
- Release tension levers and lower the ribbon carrier until it clicks into place.
- Close printer cover on the calculator.



To replace the paper in the printer, proceed as follows:

- Raise the printer cover on the calculator.
- Remove paper from the paper well.
- If any paper is left on the roll, tear the paper across, leaving the paper on the print drum.
- Turn on power to the calculator. Depress and hold the [ADV] key until the paper clears the cutter bar.
- Remove plastic holder from old roll of paper and insert through the new roll.
- Place paper roll in paper well.
- Lift paper cutter bar on the printer.
- Fold end of paper diagonally and feed paper under print roller from the back.
- Press the [ADV] key until the paper comes up on the front side of the printer roller.
- Insert paper through slot in paper cutter bar and lower the cutter bar onto the printer roller.
- Tear off the folded end of the paper and close the printer cover.



APPENDIX B. CALCULATOR MODEL CONFIGURATIONS

Monroe Model 1830 Programmable Printing Calculators are available with both expanded data storage and program step capacity. Such capability can be added to your calculator at any time. All such additions are completely internal.

The basic calculator has 64 main data storage registers and 512 programming steps. Memory expansion kits are available to increase the capacity of the basic calculator up to 512 main data registers, in increments of 64 registers, and up to 4096 program steps in increments of 512 steps.

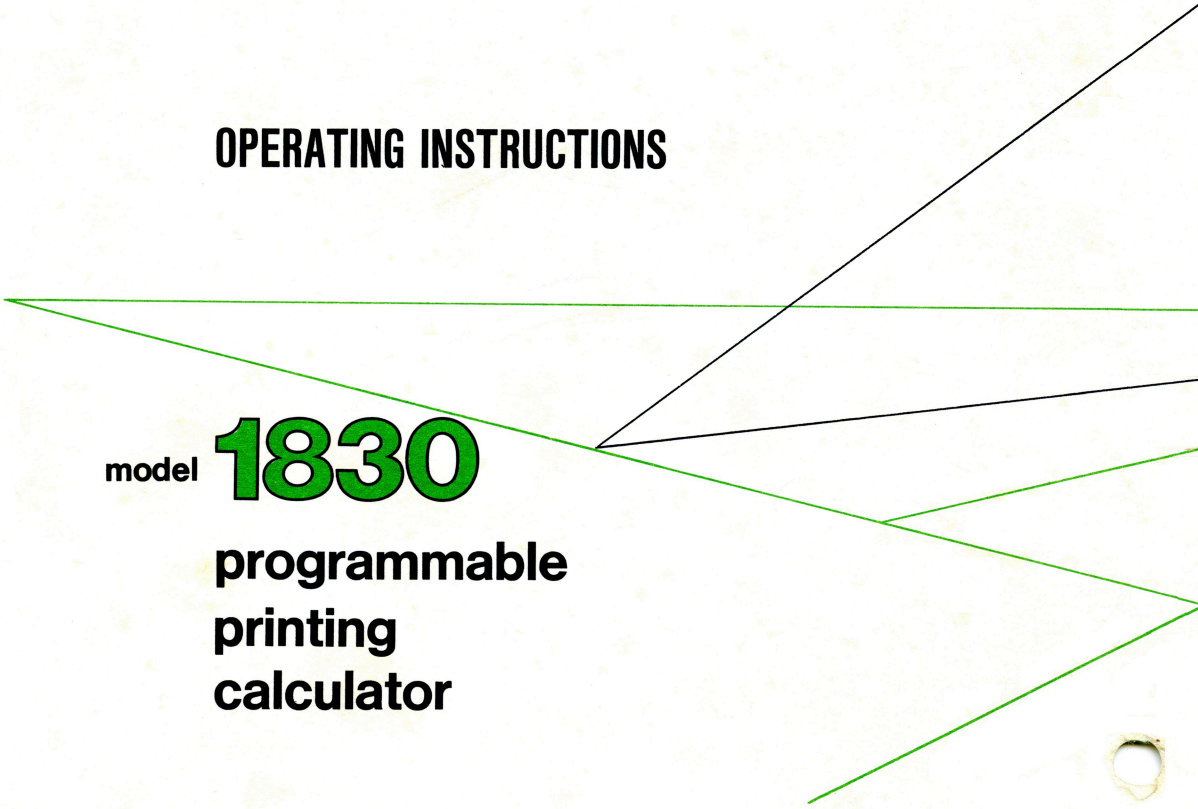
Memory configurations are designated by a two-digit number after the model number; that is 1830-xx. The first digit indicates the number of program steps; the second represents the number of main data registers, as illustrated in the following table.

Digit	Number of Program Steps	Number of Main Data Registers
1	512	64
2	1024	128
3	1536	192
4	2048	256
5	2560	320
6	3072	384
7	3584	448
8	4096	512
Examples of Memory Options		
1830-11 (Basic Calculator)	512	64
1830-13	512	192
1830-42	2048	128
1830-67	3072	448
1830-88	4096	512

OPERATING INSTRUCTIONS

model **1830**

programmable printing calculator



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